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Comparative analysis of mineral constituents of ethanol leaf and seed extracts of *Datura stramonium*

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ABSTRACT

Medicinal plants contain numerous biologically active compounds such as minerals which have physiological actions on the human body. This work was designed to analyse the mineral composition of *Datura stramonium* (*D. stramonium*) leaf and seed extracts. Dry leaves and seeds of *D. stramonium* were pulverized. The powdered sample was used for the extraction using 98% ethanol. Standard methods were used in the determination of the mineral contents. The study result showed the order of trace minerals composition of *D. stramonium* leaves and seed were as follows: Fe>Cu>Mn>Zn>Ni>Co and Cu>Fe>Zn>Mn>Ni>Co, respectively. The result showed higher value of trace minerals in *D. stramonium* leaves than the seed. There were significant difference ($p<0.05$) in the trace elements levels of the leaves and seeds with the leaves having higher mineral levels than the seed. The result also showed that macro minerals of *D. stramonium* leaves and seed were in this order: Mg>Ca>K>P. *D. stramonium* leaves had higher quantities of macro mineral than the seeds. *D. stramonium* leaves and seed used for this study have proved to be very important in drug research and development, because of the mineral composition that are present in appreciable amount. These minerals could contribute to the various pharmacological attributes of this plant. However, further research is necessary to determine other bioactive constituents present in this plant and their mechanism of action.

Keywords: Minerals, *Datura stramonium,* trace elements, macro mineral, medicinal plants, active compounds.

INTRODUCTION

Natural products from indigenous plants have been exploited by scientists and rural dwellers for medicinal and nutritional purposes. This is as a result of bioactive components inherent in them which are beneficial to humans [1] In the rural communities; people depend mostly on traditional medicine which also recognizes their socio-cultural and religious background which orthodox medicine neglects [2]. More so, rural dwellers resort to the use of medicinal plants as a result of low cost and availability of these plants when compared to the high cost and scarcity of conventional drugs [3].

Medicinal plants contain numerous biologically active compounds such as minerals and phytochemicals which have physiological actions on the human body [4]. These active compounds are used to treat various diseases like diabetes mellitus [5-9], inflammatory disorders [10-12] oxidative stress [13], malaria [14] and cancer [15]. Minerals are naturally occurring chemical compounds required by living organisms. Mineral elements are considered to be of great importance in the prevention of disease and in the general well-being of individuals as they fulfill a critical function in physiological and

biochemical processes [16]. Major minerals are those required in amounts greater than 100 mg/day and they include calcium, phosphorus, magnesium, sulfur, potassium, chloride, and sodium. Trace minerals are required in smaller amounts, less than 100 mg/day, and they include zinc, iron, silicon, manganese, copper, fluoride, iodine, and chromium. Dietary mineral deficiencies may have long-term negative effects on human health and lead to various mineral deficiency diseases [17]. Fishes are notable sources of minerals [18]. Plants are also good sources of minerals to man and animals [19-21]. *Datura stramonium* is a well-known medicinal plant that belongs to the genus *Datura* and the family Solanaceae. It originates in America but recently can be found around the world, including North, Central and South America, Europe, Asia, and Africa including Nigeria [22]. The seeds of *D. stramonium* contain amino acids (alanine, glutamate, phenylalanine, and tyrosine) including various phytochemicals, like, alkaloids, scopolamine, atropine, and hyoscyamine [23]. Pharmacological studies on extracts of different parts of *D. stramonium* have revealed the antioxidant and free radical scavenging potential [11], antimicrobial [24], anti-inflammatory [25], hepatoprotective [26], hypoglycemic activities [27] and anticholinergic potential [28]. Rural dwellers use *D. stramonium* as narcotic, anodyne, antispasmodic and also in the management and treatment of ulcers, wounds, , rheumatism and gout, bruises and swellings, fever, asthma, bronchitis and toothache [29].All parts of *D. stramonium* are toxic with the ripened seeds being the most toxic part [30]. Previous studies have been done on the pharmacological and phytochemical composition of *D. stramonium* but information about the minerals composition is scanty. Hence, the present study was designed to determine and compare the mineral composition of the leaves and seeds of *D. stramonium* using ethanol as solvent of extraction. This work attempts to contribute to knowledge of the bioactive components of this plant.

MATERIALS AND METHODS

Chemicals and Reagents

All chemicals and reagents used were of analytical grade.

Materials

Fresh leaves and seeds of fully grown *D. stramonium* were sourced from Amaozara Ozizza in Afikpo North Local Government Area of Ebonyi State in May 2022 and identified by Mr. Nwankwo Onyebuchi, a plant Taxonomist in the Department of Applied Biology Ebonyi State University, Abakaliki, Nigeria (Voucher number: EBSU-H-397).

METHODS

Preparation of the Crude Ethanol leaf Extract of *D. stramonium*

Extraction method described by Abdullahi and Mainul, [31] was used for the extraction. Harvested fresh leaves and seeds of *D. stramonium* were washed and shade dried under room temperature and later pulverized in a grinder. Four hundred grammes of each sample were soaked in 2000 ml of 98% ethanol for 72 hours at room temperature with intermittent rocking. Thereafter, it was filtered using white clean sieve cloth and the filtrate heated on a water bath at 35 °C until the solvents were completely removed (evaporated). The extracts were stored in airtight container and used for quantitative analysis of mineral content.

Determination of Mineral Compositions of Ethanol leaf and Seed Extracts of *D. stramonium*

Levels of iron, phosphorus, copper, calcium, magnesium, sodium and calcium were determined by the AOAC [32] method while zinc content was determined by the method of Pearson [33].

Statistical Analysis

Data were expressed as mean ± standard deviation (SD). Mean values were appropriately analyzed and compared using one-way analysis of variance (ANOVA) followed by Turkey's post hoc test; significance was accepted at P<0.05. All statistical analysis was carried out using Graph Pad Prism version 5.00 for Windows.

RESULTS

Minerals composition of the leaves and seeds of *D. stramonium.*

The order of trace elements composition in both leaves and seeds were as follows: Fe> Cu > Mn > Zn > Ni > Co and Cu> Fe > Zn> Mn > Ni > Co, respectively. Further, there were significant difference (p<0.05) in the trace elements levels of the leaves and seeds with the leaves having higher mineral levels than the seed. However, there was no significant difference (p>0.05) in the Zn level in both leaves and seeds. More so, macro minerals were in this order in both leaves and seeds: Mg>Ca>K>P with higher levels of minerals in leaves (Figures 1a and 1b).

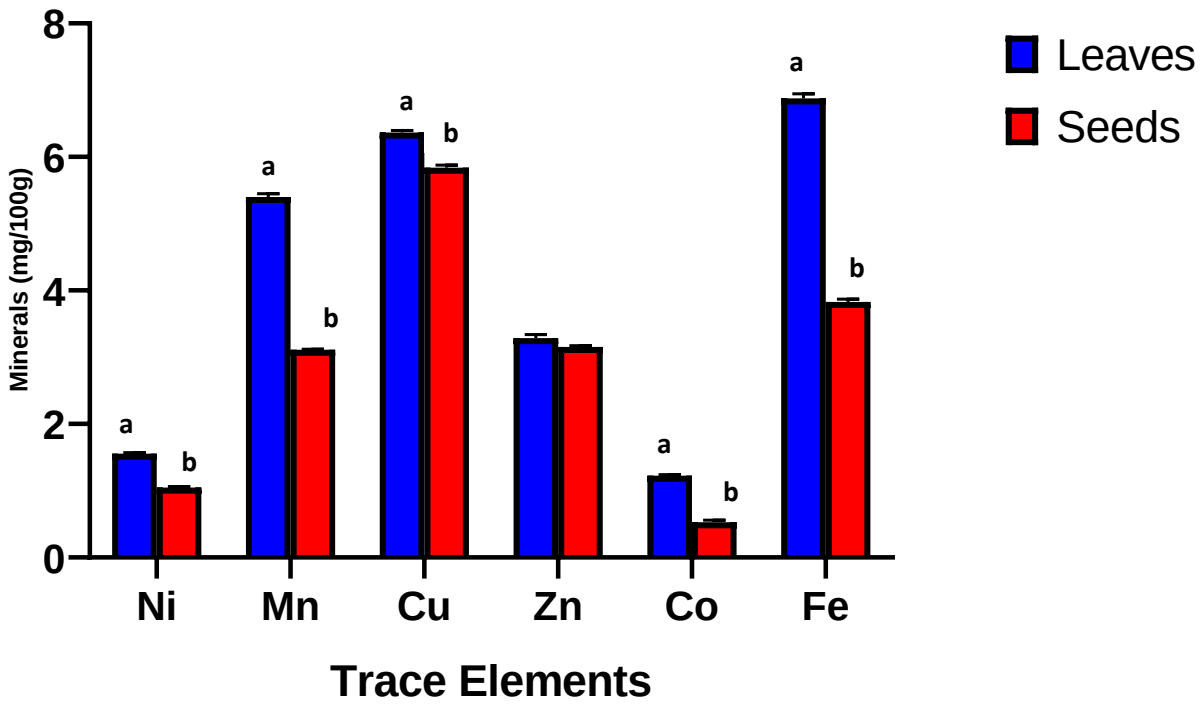

Figure 1a: Comparative trace elements composition of the leaves and seeds of *D. stramonium* expressed in mg/g. The values in the chart are the Mean± SD from triplicate determinations (n=3). Bars with no alphabets are significantly the same at (p>0.05) across the rows while bars with different alphabets are significantly different at (p<0.05) across the rows.

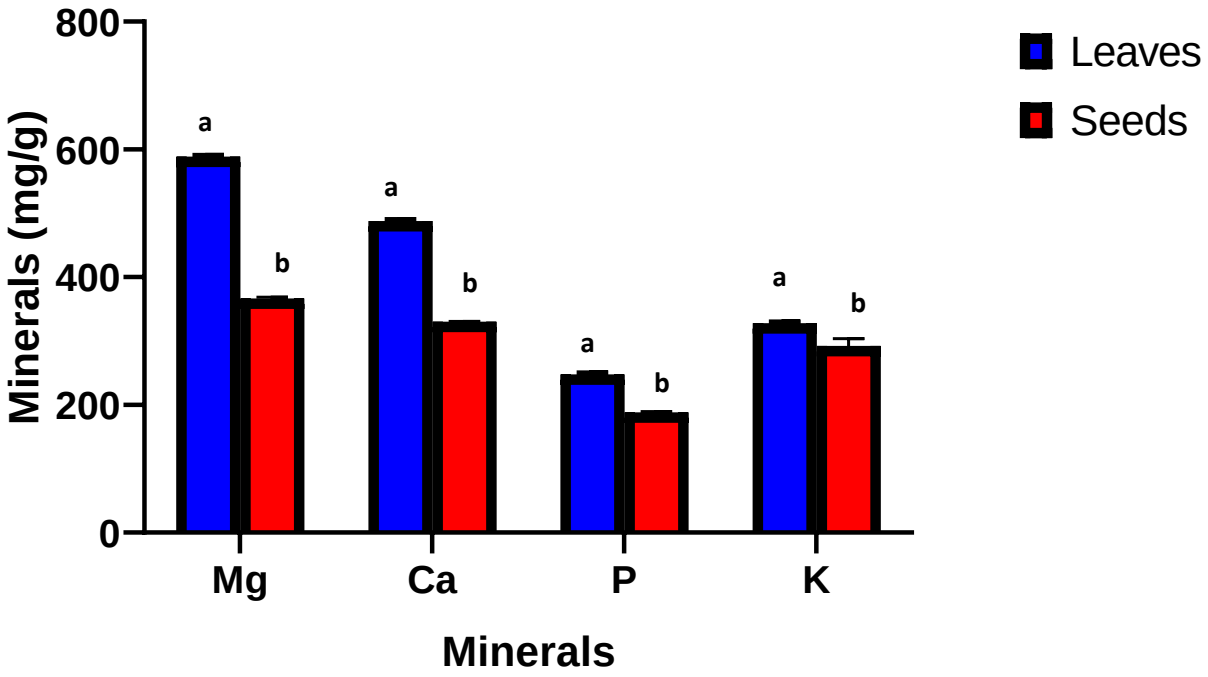

Figure 1b: Comparative macrominerals composition of the leaves and seeds of *D. stramonium* expressed in mg/g. The values in the chart are the Mean± SD from triplicate determinations (n=3). Bars with different alphabets are significantly different at ($p<0.05$) across the rows.

DISCUSSION

This work analysed the mineral composition of *D. stramonium* leaf and seed extract as a way of predicting its nutritional and medicinal potentials. The study result showed the order of trace minerals of *D. stramonium* leaves and seed in the descending order of Fe>Cu>Mn>Zn>Ni>Co and Cu>Fe>Zn>Mn>Ni>Co, respectively. The result showed higher value of trace minerals in *D. stramonium* leaves than the seed. There were significant difference ($p<0.05$) in the trace elements levels of the leaves and seeds with the leaves having higher mineral levels than the seed. However, there was no significant difference ($p>0.05$) in the Zn level in both leaves and seeds. Mineral concentrations in plants depend on various factors like the type of soil, fertilization method, plant species, and environmental conditions [34]. The appreciable concentration of minerals in *D. stramonium* leaves and seeds corroborates previous studies which indicated that medicinal plants are a good source of mineral [1,35,19,20,21].The micro minerals present in this plant (iron, zinc, nickel and cobalt and copper) perform various important functions in human physiological milieu. Manganese is essential for enzymatic activities (as a cofactor) and is also required for the formation of hemoglobin [36]. Copper is used in many enzymes as a structural constituent (cofactor). Zinc is required for energy metabolism. It stimulates beta cells of the pancreas to release insulin and thereby maintaining a normal glucose level. It is required for tissue repair and growth [37]. Iron is needed for the production of hemoglobin and transport of oxygen. It also enhances the body's immunity [38]. In this study, macro minerals of *D. stramonium* leaves and seed were in this order: Mg>Ca>K>P. *D. stramonium* leaves expressed were found to have high quantities of macromineral in the leaves than the seeds. Magnessium (588.17 ± 1.61**)** was found to be the highest seconded by calcium (487.35 ± 1.83), potassium (327.28± 1.65) and lastly phosphorus (247.13 ± 2.21), mg/g. This

study was in agreement with the study of Offor *et al.*[21] who assessed the mineral composition of *Blighia unijugata* leaves in South Eastern Nigeria. Their study revealed that *Blighia unijugata* leaves recorded the concentrations (mg/100g) of the minerals as magnesium (60.20±0.09) and phosphorus (33.72±0.02).

Magnessium is important for energy metabolism, bone formation, and enzymatic activities. Magnesium helps to maintain normal nerve and muscle function, supports a healthy immune system, keeps the heartbeat steady, and helps bones remain strong. It also helps adjust blood glucose levels. It aids in the production of energy and protein [16]. Calcium is required as a component of the human diet, and it is essential for the full activity of some enzymes. It is also necessary to maintain an optimal bone development. Besides, calcium is also good for growth and maintenance of bones, teeth and muscles [39]. Normal extra cellular calcium concentrations are necessary for blood clotting and for the integrity, intracellular cement substances [1].Potassium in fish is an essential mineral and electrolyte involved in heart function, muscle contraction, and water balance. It is necessary for the normal functioning of all cells. It regulates the heartbeat, ensures proper function of the muscles and nerves, and is vital for synthesizing protein and metabolizing carbohydrates. Potassium works with sodium in maintaining ionic equilibrium. This connection between potassium and sodium is essential in maintenance of blood pressure [40]. Phosphorus is also an important mineral as it has been reported to form the structure of teeth, bones and cell membranes. It also acts as a cofactor for many enzymes and activates the vitamin B complex [41].

CONCLUSION AND RECOMMENDATION

D. stramonium leaves and seed used for this study have proved to have good concentration of minerals and therefore could be very important in drug research and developments, especially the leave extract. We therefore, recommend the leave extract for further studies on the pharmacological assay.

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Author Contributions:

Conceptualization and Design: Esther U. Alum and Patrick M. Aja; **Data collection**: Mercy T. Oyika; **Analysis of Data:** Okechukwu P. C. Ugwu and Emmanuel I. Obeagu; **Interpretation of results**: Okechukwu P. C. Ugwu and Emmanuel I. Obeagu; **Software:** Patrick M. Aja; **Methodology:** Michael Ben Okon and Mercy T. Oyika; **Draft manuscript preparation**: Mercy T. Oyika and Esther U. Alum; **Editing and revision of manuscript**: Esther U. Alum and Chinedu O. Egwu. All authors reviewed the results and approved the final version of the manuscript

Conflict of Interest

We have no conflict of interest to declare.

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Supplementary Files

There is no data to share

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